Safe Operating Procedure

(Your Park) No.

LEAD EXPOSURE PROGRAM

Recommended By: ____ Date: ______________

(Name of Competent Person), (Your Park)

Approved By: ____ Date: ______________

Superintendent, (Your Park)

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I. Introduction:
Lead has been poisoning workers for thousands of years. In construction, lead is frequently used for roofs, cornices, tank linings, and electrical conduits. In plumbing, soft solder, used for soldering tinplate and copper pipe joints, is an alloy of lead and tin. Soft solder, in fact, has been banned for many uses in the United States. The Consumer Product Safety Commission has also banned the use of lead-based paint in residential application.

Significant lead exposures can also arise from removing paint from surfaces previously coated with lead-based paint, such as in bridge repair, residential or historic structure renovations, and demolition. The trades potentially exposed to lead include ironwork, demolition work, painting, lead-based paint abatement work, plumbing, heating/air- conditioning, electrical work, welding and carpentry/renovation/remodeling.

Operations that generate lead dust and fumes include the following:

- Flame-torch cutting, welding, the use of heat guns, sanding, scraping and grinding of lead painted surfaces in repair, reconstruction, dismantling, and demolition work;
- Abrasive blasting of bridges and other structures containing lead-based paints;
- Use of torches and heat guns, and sanding, scraping, and grinding lead-based paint surfaces during remodeling or abating lead-based paint; and
- Maintaining process equipment or exhaust duct work.

II. Purpose:
__________Your Park_____________ is responsible for the development and implementation of a worker protection program in accordance with 29 CFR 1926.62. This program is essential to minimize your risk of lead exposure. Projects vary in their scope and potential for exposing you to lead and other hazards. Many projects may involve limited exposure, such as the removal of paint from a few interior residential doors. Others may involve the removal, or stripping off, of substantial quantities of lead-based paints on larger renovations. ________________Your Park_____________ shall, as needed, consult qualified safety and health professionals to develop and implement an effective protection program.

The most effective way to protect you is to minimize exposure through the use of engineering controls and good work practices. It is OSHA's, as well as our, policy that respirators are not to be used in lieu of engineering and work practices to reduce employee exposures to below the PEL. Respirators can only be used in combination with engineering controls and work practices.

OSHA's new interim final standard for lead in construction limits worker exposures to 50 micrograms of lead per cubic meter, (50 mg/m^3), of air averaged over an eight-hour workday. At a minimum, the elements below shall be included in the protection program for employees exposed to lead:

- Hazard determination, including exposure assessment;
- Engineering and work practice controls;
- Housekeeping and personal hygiene practices and signs
- Protective clothing and equipment;
- Respiratory Protection;
- Medical surveillance and provisions for medical removal and recordkeeping; and
- Training;

To implement this program properly, the Park needs to designate a competent person, i.e., one who is capable of identifying existing and predictable hazards or working conditions which are hazardous or dangerous to employees, in accordance with the general safety and health provisions of OSHA's construction standards. The competent person must have the authorization to take prompt corrective measures to eliminate such problems. Qualified medical personnel must be available to advise the Park and employees on the health effects of employee lead exposure and supervise the medical surveillance program. The Park has designated the (Name of Competent Person) as the competent person and (Name of Qualified Medical Personnel) as our qualified medical personnel.

III Responsibilities:

Employee: As an employee of _________Your Park__________, you have the responsibility in complying with this SOP and 29 CFR 1926.62 Lead in Construction Standard. You play a key role in protecting your own health by learning about lead hazards and their controls, and by learning and following this SOP. Follow this SOP where it governs your own actions and see that the Park complies with the provisions governing our responsibilities. You shall notify your supervisor if you have difficulty breathing during a respirator fit test or while wearing your respirator. You should immediately report to your supervisor if you develop symptoms associated with lead exposure.

Some symptoms of lead exposure include loss of appetite, metallic taste, constipation, nausea, pallor, nervous irritability, muscle and joint pain, numbness, dizziness, hyper-activity and severe stomach cramps. By not recognizing the warning signs, your problems can advance to brain disorders, anemia, nerve, blood pressure, and kidney problems. Lead exposure higher than 30 mg/m^3 has also been known to cause reproductive problems in females and males. A life threatening side effect is Encephalopathy. This condition affects the brain and is preceded by vomiting, a feeling of dullness that progresses to drowsiness, stupor, poor memory, restlessness, irritability, tremor and convulsions. Encephalopathy may arise unexpectedly with the onset of seizures, followed by coma, and possible death.

Park: The park will assure that no employee is exposed to lead in excess of the Permissible Exposure Limit, (PEL), in an eight-hour Time Weighted Average, (TWA). We shall institute engineering controls and work practices with administrative controls to reduce the exposure to lead. When these controls do not reduce the exposure to lead below the PEL, they will still be used but supplemented with appropriate respiratory protection. The Park will assure that the (Name of Competent Person) and Supervisors directing work that has airborne lead levels at or above the action level complete a forty- (40) hour EPA-approved Lead Abatement Supervisor/Contractor course.

This SOP serves as the Park's written compliance program. This SOP also meets the requirements of issuing a policy prior to starting any task where exposure may reach the PEL as an eight-hour TWA.

The compliance program will include a description of operations where lead is emitted, detailing the operation and equipment used. Included will be the type of material involved, employee responsibilities and operating or maintenance procedures. In addition it must specify the means that will be used to achieve compliance. These could be engineering controls or work practices. If administrative controls are used such as job rotation to reduce employee exposure, then a copy of the schedule should be included. The plan must show the type of protective clothing and equipment used, including respirators, housekeeping, and hygiene practices that employees must use and follow. These plans are task specific and shall be covered with a Job Hazard Analysis prior to starting the work. Also, please see Appendix A.

This SOP is available to all employees and/or their designated representatives and must be reviewed and updated annually to assure the status of exposure controls.

IV Activities Covered by this Program: This program applies to all construction work where an employee may be occupationally exposed to lead. Construction work is defined as work for construction, alteration and/or repair, including painting and decorating. It includes but is not limited to the following:

- Demolition or salvage of structures where materials containing lead is present.
- Removal or encapsulation of materials containing lead.
- New construction, alteration, repair or renovation of structures, substrates, or portions thereof, that contain lead, or materials containing lead.
- Installation of products containing lead.
- Lead contamination/emergency cleanup.
- Transportation, disposal, or storage of lead containing materials on the site or location at which construction activities are performed.
- Maintenance operations associated with the construction activities described above.

V. Exemptions: In 1978 the Consumer Product Safety Commission (CPSC) established a maximum lead content in paint of 0.06%. Based on this, construction work that only disturbs paint in buildings built after 1980 will not be covered under this program.

VI. Hazard Determination & Exposure Assessment: If lead is present in the workplace, in any quantity, an initial evaluation is required to determine if any employee is exposed to lead over the action level. Acton level is defined, by OSHA, as an employee exposure, without regards to the use of respirators, to an airborne concentration of 30 micrograms per cubic meter of air (30 mg/m^3), calculated as a time-weighted-average (TWA). This is the level of exposure that would occur if you were not wearing a respirator, averaged over an 8-hour workday, and at which point certain program requirements must be implemented. Common methods to determine if you are exposed above the action level include objective data or air monitoring.

Objective data: Data may be compiled by contacting trade associations, insurance carriers, suppliers of lead containing materials, or use of exposure data collected from similar operations. If the initial determination shows that you may be exposed, without respirators, over the action level, an air monitoring system must be set up.

Air Monitoring: Air monitoring will find the exposure level of each employee or a representative number of employees and would include all job types. Sampling must be done to represent full shift exposure and under conditions that represent regular, daily exposure to lead. These conditions could be duties such as replacing electrical and plumbing components, carpentry and masonry activities or as simple as administrative duties. Within five (5) working days after the completion of the exposure assessment, the (Name of Competent Person) will notify each employee in writing of the results of their assessment. If an employee is exposed above the permissible exposure limit (PEL), a statement that the exposure was at or above the PEL and a description of the corrective action(s) to be taken to reduce the exposure level will be included with the results. A written record of the initial assessment shall be maintained is the (Name of Competent Person)'s Office. Please see Appendix B.

Other Information: The current OSHA lead standard for construction (29 CFR 1926.62) is unique in that it groups tasks presumed to create employee exposures above the PEL of 50 mg/m^3 as an 8-hour time-weighted-average. Until the employer performs an employee exposure assessment and determines actual employee exposure, the employer must assume that employees performing one of the tasks in the table below are exposed to the levels of lead indicated for that task in the table. For all three groups of tasks, employers are required to provide respiratory protection appropriate to the task's presumed exposure level, protective work clothing and equipment, change areas, hand-washing facilities, training, and initial medical surveillance as prescribed later in this program. The only difference in the provisions applying to these groups is in the degree of respiratory protection required.

LEAD-RELATED CONSTRUCTION TASKS AND
THEIR PRESUMED 8-HOUR TWA EXPOSURE LEVELS

>50 to 500 mg/m^3 >	500 mg/m^3 to 2500 mg/m^3 >	2500 mg/m^3
Manual Demolition	Using lead containing mortar	Abrasive blasting
Dry manual scraping	Lead burning	Welding
Dry manual sanding	Rivet busting	Torch cutting
Heat gun use	Power tool cleaning without dust collection systems	Torch burning
Power tool cleaning with dust collection systems	Clean-up of dry expendable abrasive blasting jobs	
Spray painting with lead paint	Abrasive blasting enclosure movement and removal	
Please Note: The OSHA standard requires initial airborne exposure monitoring, therefore the use of the table should not be substituted for initial monitoring for lead abatement work.		

Employees involved in construction activities that may occupationally expose them to lead above the PEL shall be provided with the following interim protection during the exposure assessment.

- Appropriate respiratory protection and training
- Appropriate personal protective clothing and equipment
- Change areas and hand-washing facilities
- Biological monitoring
- Hazard communication training
- Training on any operations that could result exposures above the action level

It is the responsibility of the Park to provide the above interim protection.

Frequency of Exposure Assessment: If the initial determination reveals that a certain activity does not expose employees above the action level, no additional exposure assessments will be required unless the activity changes. If the initial determination or subsequent determinations reveals an exposure at or above the action level, the Park must continue to monitor in accordance with the lead in construction standard.

VII Engineering & Work Practice Controls: A competent person should review all site operations and stipulate the specific engineering controls and work practices designed to reduce worker exposure to lead. Engineering measures include local and general exhaust ventilation, process and equipment modification, material substitution, component replacement, and isolation or automation. Examples of recommended engineering controls that can be used to reduce worker exposure to lead are as follows:

Exhaust Ventilation: Power tools used for the removal of lead-based paint should be equipped with dust collection shrouds or other attachments exhausted through a high-efficiency particulate air (HEPA) vacuum system. Operations such as welding, cutting/burning, heating should be provided with local exhaust ventilation. HEPA vacuums should be used during clean-up activities.

For abrasive blasting operations where full containment exists or is required, the containment structure should be designed to optimize the flow of ventilation air past the worker(s), so that the airborne concentration of lead is reduced and visibility is increased. The affected area should be maintained under negative pressure to reduce the chances that lead dust would contaminate areas outside the enclosure. A containment structure should be equipped with dust collection and an air-cleaning device to control emissions of particulates to the environment.

Enclosure/Encapsulation: Lead-based paint can be made inaccessible either by encapsulating it with a material that bonds to the surface, such as acrylic or epoxy coating or flexible wall coverings, or by enclosing it using systems such as gypsum wallboard, plywood paneling, and aluminum, vinyl or wood exterior siding. Floors coated with lead-based paint can be covered using vinyl tile or linoleum flooring.

The Park and Supervisors shall inform the custodial and maintenance staffs and contractors with regard to all activities that involve enclosed or encapsulated lead- based paint. This will minimize potential inadvertent release of lead during maintenance, renovation, or demolition.

Substitution: Zinc-containing primers covered by an epoxy intermediate coat and polyurethane topcoat are commonly used instead of lead-containing coatings.

Mobile hydraulic shears can be substituted for torch cutting under certain circumstances.

Surface preparation equipment, such as needle guns with multiple reciprocating needles completely enclosed within an adjustable shroud, can be substituted for abrasive blasting under certain operations. The shroud captures dust and debris at the cutting edge and can be equipped with a HEPA vacuum filtration system with a self-drumming feature. One such commercial unit can remove lead-based paint from flat steel and concrete surfaces, outside edges, inside corners, and pipes.

Chemical strippers used primarily on the exterior of buildings, surfaces involving carvings or molding, or intricate iron works, can be used in place of hand scraping using a heat gun. Chemical removal generates less airborne lead dust.

These strippers, however, can be hazardous and the material safety data sheets (MSDSs) for the products used must be reviewed by the Park for information on worker exposure hazards from the chemical ingredients and protective measures recommended by the manufacturer.

Component Replacement: Lead-based painted building components (i.e., windows, doors, and trim) can be replaced either with new components free of lead- containing paint or with the same components after the paint has been removed off-site. Replacement is a permanent solution.

Process/Equipment Modification: Brush/roller application of lead paints or other lead-containing coatings is a safer method than spraying. (Note: There is a ban on the use of lead-based paint in residential housing.) This method of application introduces little or no paint mist into the air where it can present a lead inhalation hazard.

Non-silica containing abrasive (e.g., steel or iron shot/grit) should be used where practical instead of sand in abrasive blasting operations. The free silica portion of the dust presents a respiratory health hazard.

Blasting techniques that are less dusty than abrasive blasting and that can be effective under some conditions include: (1) hydro- or wet-blasting (using high pressure water with or without abrasive or surrounding the blast nozzle with a ring of water), and (2) vacuum blasting where a vacuum hood for material removal is positioned around the exterior of the blasting nozzle.

Heat guns used to remove lead-based paints in residential housing units should be of the flameless electrical softener type. Heat guns should have electronically controlled temperature settings to allow usage below 700 degrees F. Heat guns should be equipped with various nozzles to cover all common applications and to limit heated work area.

When using abrasive blasting with vacuum on exterior building surfaces, care should be taken that the configuration of the heads on the blasting nozzle match the configuration of the substrate so that the vacuum is effective in containing debris.

Since HEPA vacuum cleaners can be used to clean surfaces other than just floors, operators should have attachments appropriate for use on unusual surfaces. The proper use of brushes of various sizes, crevice tools and angular tools, when needed, will enhance the quality of the HEPA-vacuuming process and help reduce the amount of lead dust released into the air.

Isolation: Although it is not feasible to completely enclose and ventilate some abrasive blasting operations, it is possible to isolate many operations to help reduce the potential for exposure to lead. Isolation, in this instance, consists of keeping employees not involved in the blasting operations as far away as possible from the work area. By placing the employees at a greater distance from the source of lead exposure, their exposures will be reduced.

VIII Housekeeping and Personnel Hygiene Practices:

Lead is a cumulative and persistent toxic substance that poses a serious health risk. A rigorous housekeeping program and adherence to basic personal hygiene practices will minimize employee exposure to lead. In addition, these two elements of the protection program will help to prevent taking lead-contaminated dust out of the worksite and home to the workers' families, thus ensuring that the duration of lead exposure does not extend beyond the workshift and providing added protection to employees and their families.

Housekeeping: An effective housekeeping program involves at least daily removal of accumulations of lead dust and lead-containing debris. Vacuuming lead dust with high-efficiency particulate air (HEPA)- filtered equipment or wetting it with water before sweeping are effective control measures. Such cleaning operations should be conducted, whenever possible, at the end of the day, after normal operations ceases. Furthermore, all persons doing the cleanup should be provided with suitable respiratory protection and personal protective clothing to prevent contact with lead.

All lead-containing debris and contaminated items accumulated for disposal should be collected and put into sealed impermeable bags or other closed impermeable containers. Bags and containers should be appropriately labeled as lead-containing waste. These measures are especially important as they minimize additional sources of exposure that engineering controls generally are not designed to control.
In addition, post the following warning sign in each work area were employees are exposed above the PEL:

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

Personal Hygiene Practices: To minimize exposure to lead, special attention should be given to workers' personal hygiene. The Park must provide and ensure that workers use washing facilities. Clean change areas, and separate non-contaminated eating areas must also be provided. Cars should be parked where they will not be contaminated with lead. These measures will reduce the worker's period of exposure to lead and the ingestion of lead, ensure that the duration of lead exposure does not extend beyond the workshift, significantly reduce the movement of lead from the worksite, and provide added protection to employees and their families.

Change Areas: The Park must provide a clean change area equipped with storage facilities for uniforms or street clothes and a separate area with facilities for the removal and storage of lead-contaminated protective work clothing and equipment. This separation is essential in preventing cross contamination of the employee's clothing.

Clean change areas are to be used for removing clothes, suiting up in clean protective clothing, donning respirators prior to beginning work, and dressing in uniforms or street clothes after work. No lead-contaminated items should enter this area.

Work clothing must not be worn away from the job site. Under no circumstances shall lead-contaminated work clothes be laundered at home or taken from the worksite, except to be laundered professionally or properly disposed of following applicable Federal, state, and local regulations.

Showers: When there is potential for extensive contamination of the employees' skin, hair, and protective clothing, shower facilities must be provided if feasible so that exposed employees can wash lead from their skin and hair prior to leaving the worksite. Where showers are provided, employees must change out of their work clothes and shower before changing into their street clothes and leaving the worksite.

Workers who do not change into clean clothing before leaving the worksite may contaminate their homes and automobiles with lead dust. Other members of the household may then be exposed to harmful amounts of lead.

Personal Practices (eating, drinking, etc.): The Park must ensure that employees who work with lead clean or remove their protective clothing and wash their hands and face prior to eating, drinking, smoking or applying cosmetics. Also, these practices are never permitted while in the work area or in areas subject to the accumulation of lead. HEPA vacuuming can be used to remove loose contamination from the work clothing prior to eating.

Washing Facilities: Adequate washing facilities shall be provided for employees. Such facilities shall be in near proximity to the worksite and provided with water, soap, and clean towels to enable employees to remove lead contamination from their skin.

Contaminated water from washing facilities and showers must be disposed of in accordance with applicable local, state, or federal regulations.

End-of-Day Procedures: Workers who are exposed to lead shall follow these procedures upon finishing work for the day:

- Place disposable coveralls and shoe covers with the lead waste;
- Place lead-contaminated clothes, including work shoes, and personal protective equipment for laundering/cleaning (by the employer) in a closed container;
- Take a shower and wash hair; and
- Change into uniforms or street clothes.

IX Protective Clothing & Equipment:

The Park must provide employees who are exposed to lead above the PEL and for whom the possibility of skin contamination or skin or eye irritation exist, clean, dry protective work clothing and equipment. Appropriate changing facilities must also be provided. Appropriate protective work clothing and equipment used on construction sites can include:

- coveralls or other full-body work clothing;
- gloves;
- vented goggles or face shields with protective spectacles or goggles; and
- welding or blasting helmets, when required.

Disposable coveralls and separate shoe covers may be used, if appropriate, to avoid the need for laundering. Non-disposable coveralls shall be replaced daily. If an employee leaves the work area wearing protective clothing, the clothing should be cleaned with high-efficiency particulate air (HEPA) filter vacuum equipment to remove loose particle contamination; or as an alternative, the coveralls should be removed. Before respirators are removed, HEPA vacuuming or other suitable method, such as damp wiping, shall be used to remove loose particle contamination on the respirator and at the facemask seal. Use work garments of appropriate size, and use duct tape to reinforce their seams (e.g., underarm, crotch, and back).

Contaminated clothing that is to be cleaned, laundered or disposed of shall be placed in closed containers. Containers shall be labeled with the following warning:

CAUTION: Clothing contaminated with lead.
Do not remove dust by blowing or shaking.
Dispose of lead-contaminated wash water in accordance with applicable local, state, or federal regulations.

Persons responsible for handling contaminated clothing shall be informed of the potential hazard in writing. At no time shall lead be removed from protective clothing or equipment by any means that disperses lead into the work area, such as brushing, shaking, or blowing.

At no time shall workers be allowed to leave the worksite wearing lead-contaminated clothing or equipment, e.g. shoes, coveralls, or headgear.

All contaminated clothing and equipment shall be prevented from reaching the worker's home or vehicle. This is an essential step in reducing the movement of lead contamination from the workplace into a worker's home and provides added protection to employees and their families.

Gloves and protective clothing should be appropriate for the specific chemical exposure (e.g., solvents and caustics). Cotton gloves provide some protection against the contamination of hands and cuticles with lead dust. Workers should wear clothing that is appropriate for existing weather and temperature conditions under the protective clothing.

Heat stress: Workers wearing protective clothing can face a risk from heat stress. Additionally, heat stress may be an important concern when working in a hot environment or within containment structures. Heat stress is caused by a number of interacting factors, including environmental conditions, type of protective clothing worn, the work activity required, and the individual characteristics of the employee.

In situations where heat stress is a concern, the Park should use appropriate work/rest regimens and provide heat stress monitoring that includes measuring employee's heart rates, body temperatures, and weight loss.

A source of water or electrolytic drink shall be close to the work area (in a non-contaminated eating/drinking area) so that it will be used often. Workers should wash their hands and face prior to drinking any fluid. Frequent fluid intake throughout the day will replace body fluids lost to evaporation. If such measures are used to control heat stress, protective clothing can be safely worn to provide the needed protection against lead exposure. The possibility of heat stress and its signs and symptoms should be discussed with all workers.

X Respirator Program: Although engineering and work practice controls are the primary means of protecting workers, source control at many sites is often not sufficient to control exposure, and airborne lead concentrations may be high or may vary widely. Respirators must often be used to supplement engineering controls and work practices whenever these controls are technologically incapable of reducing worker exposures to lead to or below 50 mg/m^3.

When respirators are provided, the Park must establish a respiratory protection program in accordance with the OSHA standard on respirator protection, 29 CFR 1910.134.

Minimum requirements for an acceptable respirator program for lead include the following elements:

- Written standard operating procedures governing the selection and use of respirators;
- Selection of respirators on the basis of hazards to which the worker is exposed;
- Instruction and training in the proper use of respirators and their limitations;
- Regular inspection and cleaning, maintenance and disinfection; worn or deteriorated parts must be replaced, including replacement of the filter element in an air-purifying respirator whenever an increase in breathing resistance is detected.
- Storage in a clean and sanitary location and protection against sunlight and physical damage;
- Appropriate surveillance of work area conditions and degree of worker exposure or stress (physiological or psychological) must be maintained;
- Evaluation to determine the continued effectiveness of the program;
- Physician's determination that the employee is physically able to perform the work and wear a respirator while performing the work;
- Use of Mine Safety and Health Administration/National Institute for Occupational Safety and Health (MSHA/NIOSH) certified respirators;
- Qualitative or quantitative fit testing of negative-pressure respirators. Fit testing is to be performed at the time of the initial fitting and at least semiannually thereafter.
- Breathing air used for supplied-air respirators must meet the requirements prescribed in 1910.134(d)(1); and
- Standing permission for employees to leave the work area to wash their faces and respirator face pieces whenever necessary to prevent skin irritation associated with respirator use.

RESPIRATOR SELECTION: Lead concentrations may vary substantially throughout a workshift as well as from day-to-day. The highest anticipated work concentration is to be used in the initial selection of an appropriate respirator.

NIOSH recommended respiratory protection for workers exposed to inorganic lead

Condition	Minimum respiratory protection *
Less than or equal to 0.5 mg/m^3 (10 x PEL) **	Any air-purifying respirator with a high-efficiency particulate filter
Less than or equal to 1.25 mg/m^3 (25 x PEL)	Any powered, air-purifying respirator with a high-efficiency particulate filter, or Any supplied-air respirator equipped with a hood or helmet and operated in a continuous-flow mode (for example, type CE abrasive blasting respirators)
Less than or equal to 2.5 mg/m^3 (50 x PEL)	Any air-purifying, full-facepiece respirator with a high efficiency particulate filter, or Any powered, air-purifying respirator with a tight fitting facepiece and a high-efficiency particulate filter
Less than or equal to 50 mg/m^3 (1,000 x PEL)	Any supplied-air respirator equipped with a half-mask and operated in a pressure-demand or other positive pressure mode
Less than or equal to 100 mg/m^3 (2,000 x PEL)	Any supplied-air respirator equipped with a full face-piece and operated in a pressure-demand or other positive-pressure mode
Planned or emergency entry into environments containing unknown concentrations or concentrations above 100 mg/m^3 (2,000 x PEL)	Any self-contained breathing apparatus equipped with a full facepiece and operated in a pressure-demand or other positive-pressure mode, or Any supplied-air respirator equipped with a full face-piece and operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode
Firefighting	Any self-contained breathing apparatus equipped with a full facepiece and operated in a pressure-demand or other positive pressure mode
Escape only	Any air-purifying, full-facepiece respirator with a high-efficiency particulate filter, or Any appropriate escape-type, self-contained breathing apparatus
* Only NIOSH/MSHA-approved equipment should be used. ** Multiple of the OSHA PEL for general industry.	

NIOSH type CE respirators are required for use by abrasive blasting operators [29 CFR 1910.94]. Currently, only continuous-flow respirators are certified by NIOSH for abrasive blasting [29 CFR 1910.94], but positive-pressure, supplied-air respirators would provide greater protection [NIOSH 1987b; 30 CFR 11]. The continuous-flow respirators are recommended by NIOSH only for airborne concentrations less than or equal to 25 times the OSHA PEL for general industry--50 mg/m^3 [NIOSH 1987b]. Furthermore, manufacturer's instructions regarding quality of air, air pressure, and inside diameter and length of hoses must be strictly followed. Use of longer hoses, hoses having a smaller inside diameter, or hoses with kinks and bends may restrict the flow of air to the respirator.

In all cases, respiratory protection should be donned before entering the contaminated work area, and it should be removed only after the worker has left that area.

In addition, if exposure monitoring or experience indicates airborne exposures to contaminants other than lead, such as solvents or polyurethane coatings, these exposures must be considered when selecting respiratory protection. A reevaluation of the respiratory protection program is required when a worker demonstrates a continued increase in blood lead levels.

For more information on Respirators, see the Park Respiratory Protection Plan.

XI Medical Surveillance: When a construction employee is occupationally exposed to lead at or above the action level of 50 mg/m^3 on any one day in a calendar year, the employee must be provided initial medical surveillance consisting of biological monitoring in the form of blood sampling and analysis for lead and zinc protoporphyrin levels. Blood lead levels are currently the best indicators of personal lead exposure. Workers potentially exposed to lead at or above the action level must be monitored for the presence of lead in the blood and the effects of lead on the blood-forming system. Full medical surveillance is to be provided to employees exposed to lead at or above the action level for more than 30 days per year. All medical examinations and consultations shall be performed by or under the direct supervision of a qualified physician and shall be provided to employees at no cost, without loss of pay, and at a reasonable time and place. A qualified physician is a doctor of medicine (M.D.) or osteopathy (D.O.) familiar with the objectives and requirements of a medical surveillance program for lead exposure.

The following conditions necessitate an immediate medical consultation including, as determined by the qualified physician, a physical examination and a blood sample for lead analysis (biological monitoring):

- whenever a worker develops signs or symptoms associated with lead toxicity; and
- before a worker restarts work following medical removal.

Biological Monitoring: The purpose of biological monitoring is to identify workers with elevated blood lead levels. The data from biological monitoring is objective evidence of a worker's body burden from lead exposure and this data can be used to follow changes in worker exposure.

Blood lead and zinc protoporphyrin (ZPP) or free erythrocyte protoporphyrin (FEP) shall be monitored for those workers exposed to lead. In general, workers in high-risk occupations should be monitored as often as needed to prevent adverse health effects.

A laboratory currently approved by OSHA shall conduct analysis of blood samples. The Park shall contact their local OSHA area office for a current list of approved labs.

Reproductive Hazard Issues: Lead is toxic to both male and female reproductive systems. Workers who are actively seeking to have a child or who are pregnant should contact qualified medical personnel to arrange for a job evaluation and medical follow-up. Supervisors who have been contacted by employees, who have been exposed to lead, with concerns about reproductive issues should refer them to qualified medical personnel.

Written Medical Opinion: The park must obtain a written and signed opinion from the examining physician for each medical examination performed for each employee. This opinion should contain the results of the medical examination as they relate to occupational exposure to lead and must include:

- whether the employee has any detected medical condition which would place his/her health at increased risk from lead exposure;
- any special protective measures or limitations on worker's exposure to lead;
- any limitation on respirator use;
- results of blood lead determination; and
- a statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

Findings of lab results or diagnoses unrelated to the workers' exposure to lead must not be communicated to the

Park or included in a written opinion.

Employees should be advised by each physician of any medical condition, occupational or non-occupational, which necessitates further medical evaluation or treatment. The Park shall furnish the employee with a copy of the written medical opinion.

Chelation: The use of chelating drugs, as a prophylactic measure (i.e., to prevent a detectable rise in blood lead) is an unacceptable medical practice. Chelation may be used by a qualified physician only for diagnostic or therapeutic reasons (that is, to diagnose or treat the signs and symptoms of severe lead toxicity).

Medical Removal: Medical removal will protect worker health both by stopping further occupational exposure and by enabling the worker to excrete the absorbed lead naturally. With good engineering, work practices, personal hygiene, and respiratory protection practices in place, very few employees should reach the medical removal trigger level specified in the OSHA standard.

OSHA's interim final standard for lead in construction uses a medical removal trigger level of 50 ug/dl. However, some authorities believe that medical removal should take place at lower levels.

Actions required by the OSHA standard for various lead concentrations in blood (BLLs)

Number of tests	BLL * (µg/dl)	Action required
1	Greater than or equal to 40	Notification of worker in writing; medical examination of worker and consultation
3 (average)	Greater than or equal to 50	Removal of worker from job with potential lead exposure
1	Greater than or equal to 60	Removal of worker from job with potential lead exposure
2	Less than 40	Reinstatement of worker in job with potential lead exposure
* In the OSHA general industry standard for lead, BLLs are reported in micrograms per 100 grams (μg/100 g) of whole blood, which is approximately equal to μg/dl.		

Presently, 15 states require laboratories and health care providers to report cases of elevated blood lead concentrations to their state Health Departments. They are:

Alabama	California	Colorado	Connecticut
Illinois	Iowa	Maryland	Massachusetts
Michigan	New Jersey	New York	Oregon
Texas	Utah	Wisconsin	

Preventing Lead Poisoning in Construction Workers: When employees are removed, or otherwise limited, they must be placed in jobs that will not result in exposure to lead at or above the action level of 50 mg/m^3. The Park may return the employee to his or her former job status when a qualified physician's medical determination is that the employee is no longer at risk from exposure to lead or when the employee's blood lead level drops below 40 ug/dl.

In the case of medical removal, records must include the following information:

- the name and social security number of the worker;
- the date of each occasion that the worker was removed from current exposure to lead;
- the date on which the worker was returned to his or her former job status;
- a brief explanation of how each removal was or is being accomplished; and

- a statement indicating whether or not the reason for the removal was an elevated blood lead level.

The Park must maintain this record for at least the duration of any worker's employment.

Recordkeeping: The Park must maintain any employee exposure and medical records to document ongoing employee exposure, medical monitoring and medical removal of workers. This data provides a base to properly evaluate the employee's health.

The Park must properly record cases on their OSHA form 200 or in the SMIS System when the worker:

- has a blood lead level that exceeds 50 mg/dl;
- has symptoms of lead poisoning, such as colic, nerve damage, renal damage, anemia, or gum problems; or receives medical treatment to lower blood lead levels or for lead poisoning.

In addition, employees or former employees, their designated representatives, and OSHA must be provided access to exposure and medical records in accordance with 29 CFR 1910.20.

XII Training: Workers should receive training [29 CFR 1926.62] that includes the following:

- Information about the potential adverse health effects of lead exposure
- Information about the early recognition of lead intoxication
- Information in material safety data sheets for new paints or coatings that contain lead or other hazardous materials.
- Instruction about heeding signs that mark the boundaries of lead-contaminated work areas
- Discussion of the importance of personal hygiene practices in reducing lead exposure
- Instruction about the use and care of appropriate protective equipment (including protective clothing and respiratory protection)
- Information about specific work practices for working safely with lead-containing paints
- Hazardous Communication

XIII Contractors: Park or Regional contracting officers and/or their designated representatives shall insure that contractors and subcontractors that perform work covered under the Lead in Construction Standard shall be responsible for insuring that their work is done in compliance with 29 CFR 1926.62 with Amendments.

XIV Summary of Program: ___________Your Park___________ employees that perform work that exposes them to airborne concentrations of lead **at or above the action level** and after all engineering and work practice controls have been exhausted shall be provided with the following:

- Respirators approved for protection against lead dust, fume, and mist by the Mine Safety and Health Administration (MSHA) and the National Institute for Occupational Safety and Health (NIOSH). All employees that require a respirator must be trained in the Park respiratory Protection Program in accordance with 29 CFR 1910.134 (1998)
- Protective clothing and equipment that prevents contamination of the employees' garments.
- Clean change areas equipped with separate storage facilities for protective work clothing, equipment, and uniforms or street clothing.
- Where feasible, hand-washing and shower facilities.
- Medical examination and blood lead level surveillance.
- Medical removal protection in accordance with the lead in construction standard.
- Lunchroom facilities that are as free as practicable from lead contamination.
- Initial and annual training in accordance with the lead in construction standard.

Supervisors directing work that exposes employees to airborne concentrations of lead at or above the action level shall be responsible for the following:

- Establish and implement a Job Hazard Analysis (JHA) or Behavioral Job Analysis (BJA) for any activities that expose employees above the action level. The (Name of Competent Person) must approve all JHA's or BJA's.
- A supervisor directing work that has airborne lead levels at or above the action level must complete a forty- (40) hour EPA-approved Lead Abatement Supervisor/Contractor course.
- Ensure that employees have received the appropriate training.
- Ensure that engineering controls and safe work practices are used to reduce lead exposure. Also, ensure that sanding and scraping of lead paint and sweeping of lead debris is done only after the material has been wetted.
- Ensure that food, beverages, and tobacco products are not present or consumed and cosmetics are not applied in the work area.
- Ensure that employees wash their hands and face prior to eating and do not enter the lunchroom with contaminated clothing or equipment.
- Ensure that the job site is clean and all surfaces are maintained as free as practicable from accumulations of lead dust. At the completion of the project, ensure that the area is cleaned properly.
- Inform building occupants of the nature and duration of the work to be conducted.
- Post the following warning sign in each work area were employees are exposed above the PEL:

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

- Ensure that hazardous waste is disposed of in compliance with Federal, State and local regulations.
- Ensure that employees remove their protective clothing in the appropriate area at the end of the work period. Also, ensure that all contaminated protective clothing which is to be cleaned, laundered, or disposed of is placed in a closed and properly labeled container(s). Notify in writing any person that cleans or launders the protective clothing of the potentially harmful effects of exposure to lead.
- When respirators are required, ensure that employees are trained in their use, have been fit tested, and wear them properly.
- Ensure that all safety and health regulations and procedures are followed.

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Appendix A: CONTROLLING LEAD EXPOSURES WITH ENGINEERING AND WORK PRACTICE CONTROLS

INTRODUCTION: This appendix provides _______Your Park__________ employees and supervisors with general information on the types of construction activities involving exposure to lead and the feasible engineering and work practice controls to reduce these exposures. The construction activities identified range from those such as abrasive blasting and welding, cutting, and burning, where exposures to lead are often high, to encapsulating lead-based paint or using lead pots, where exposures are generally low.

The material in this appendix will help _________Your Park___________ employees and supervisors apply their resources to the industrial-hygiene problems associated with lead exposures in the construction industry. General engineering and work practice controls that can be applied to almost any construction activity are addressed below.

This appendix also describes those lead-related tasks and operations that give rise to lead exposures among construction workers. Recommended, feasible engineering controls (e.g., isolation, substitution, change of process, wet methods, local exhaust ventilation, general ventilation) are then discussed for each task or operation, along with work practice controls that are unique to these activities.

The current OSHA standard (29 CFR 1926.62) for lead exposure in construction has a permissible exposure limit (PEL) of 50 micrograms per cubic meter of air (50 mg/m^3), measured as an 8-hour time-weighted average (TWA). As with all NPS and OSHA health standards, when the PEL is exceeded, the hierarchy of controls requires employers to institute feasible engineering and work practice controls as the primary means to reduce and maintain employee exposures to levels at or below the PEL. When all feasible engineering and work practice controls have been implemented but have proven inadequate to meet the PEL, employers must nonetheless implement these controls and must supplement them with appropriate respiratory protection. The employer also must ensure that employees wear the respiratory protection provided when it is required.

Certain lead-related construction tasks commonly produce exposures above the PEL and often orders of magnitude above the PEL. The OSHA lead standard for construction is unique in that it groups tasks that are presumed to be associated with employee exposures above the PEL into three lead-exposure ranges. The exposure ranges assigned to the different categories of tasks are based on data collected by OSHA and other sources including two advisory groups.

Until the Park performs an employee-exposure assessment and determines the magnitude of the exposures actually occurring during the lead-related activity, the Park must assume that employees performing that task are exposed to the lead concentrations indicated in the table on Page 3 of this program. For all three groups of tasks, employers are required to provide respiratory protection appropriate to the task's presumed exposure level, protective work clothing and equipment, change areas, hand-washing facilities, training, and the initial medical surveillance prescribed by paragraph (d)(2)(v) of the standard (29 CFR 1926.62). Also refer to Page 10 of this program. The only difference in the provisions applying to the three categories of tasks is the degree of respiratory protection required.

ENGINEERING CONTROLS: Engineering controls, such as ventilation, and good work practices are the preferred methods of minimizing exposures to airborne lead at the worksite. The engineering control methods that can be used to reduce or eliminate lead exposures can be grouped into three main categories: (1) substitution, (2) isolation, and (3) ventilation. Engineering controls are the first line of defense in protecting workers from hazardous exposures.

SUBSTITUTION: Substitution includes using a material that is less hazardous than lead, changing from one type of process equipment to another, or even, in some cases, changing the process itself to reduce the potential exposure to lead. In other words, material, equipment, or an entire process can be substituted to provide effective control of a lead hazard. However, in choosing alternative methods, a hazard evaluation should be conducted to identify inherent hazards of the method and equipment.

Examples of substitution include:

- Use of a less hazardous material: applying a nonleaded paint rather than a coating that contains lead.
- Change in process equipment: using less dusty methods such as vacuum blast cleaning, wet abrasive blast cleaning, shrouded power tool cleaning, or chemical stripping to substitute for open abrasive blast cleaning to reduce exposure to respirable airborne particulates containing lead.
- Change in process: performing demolition work using mobile hydraulic shears instead of a cutting torch to reduce exposure to lead fumes generated by heating lead compounds.

Any material that is being considered as a substitute for a lead-based paint should be evaluated to ensure that it does not contain equally or more toxic components (e.g., cadmium or chromate). Because substitute materials can also be hazardous, employers must obtain a Material Safety Data Sheet (MSDS) before a material is used in the workplace. If the MSDS identifies the material as hazardous, as defined by OSHA's hazard communication standard (29 CFR 1926.59), an MSDS must be maintained at the job site and proper protective measures must be implemented prior to usage of the material.

ISOLATION: Isolation is a method of limiting lead exposure to those employees who are working directly with it. A method which isolates lead contamination and thus protects both nonessential workers, bystanders, and the environment is to erect a sealed containment structure around open abrasive blasting operations. However, this method may substantially increase the lead exposures of the workers doing the blasting inside the structure. The containment structure must therefore be provided with negative-pressure exhaust ventilation to reduce workers' exposure to lead, improve visibility, and reduce emissions from the enclosure.

VENTILATION: Ventilation, either local or dilution (general), is probably the most important engineering control available for the employees to maintain airborne concentrations of lead at acceptable levels. Local exhaust ventilation, which includes both portable ventilation systems and shrouded tools supplied with ventilation, is generally the preferred method. If a local exhaust system is properly designed, it will capture and control lead particles at or near the source of generation and transport these particles to a collection system before they can be dispersed into the work environment.

Dilution ventilation, on the other hand, allows lead particles generated by work activities to spread throughout the work area and then dilutes the concentration of particles by circulating large quantities of air into and out from the work area. For work operations where the sources of lead dust generation are numerous and widely distributed (e.g., open abrasive blasting conducted in containment structures), dilution ventilation may be the best control.

Examples of ventilation controls include:

- Power tools that are equipped with dust collection shrouds or other attachments for dust removal and are exhausted through a HEPA vacuum system;

- Vacuum blast nozzles (vacuum blasting is a variation on open abrasive blasting). In this type of blasting, the blast nozzle has local containment (a shroud) at its end, and containment is usually accomplished through brush-lined attachments at the outer periphery and a vacuum inlet between the blast nozzle and the outer brushes.
- Containment structures that are provided with negative-pressure or dilution ventilation systems to reduce airborne lead concentrations within the enclosure, increase visibility, and control emissions of particulate matter to the environment.

WORK PRACTICE CONTROLS: Work practices involve the way a task is performed. OSHA has found that appropriate work practices can be a vital aid in lowering worker exposures to hazardous substances and in achieving compliance with the PEL. Some fundamental and easily implemented work practices are: (1) good housekeeping, (2) use of appropriate personal hygiene practices, (3) periodic inspection and maintenance of process and control equipment, (4) use of proper procedures to perform a task, (5) provision of supervision to ensure that the proper procedures are followed, and (6) use of administrative controls.

HOUSEKEEPING: A rigorous housekeeping program is necessary in many jobs to keep airborne lead levels at or below permissible exposure limits. Good housekeeping involves a regular schedule of housekeeping activities to remove accumulations of lead dust and lead-containing debris. The schedule should be adapted to exposure conditions at a particular worksite. All workplace surfaces must be maintained as free as practicable of accumulations of lead dust. Lead dust on overhead ledges, equipment, floors, and other surfaces must be removed to prevent traffic, vibration, or random air currents from re-entraining the lead-laden dust and making it airborne again. Regularly scheduled clean-ups are important because they minimize the re-entrainment of lead dust into the air, which otherwise serves as an additional source of exposure that engineering controls are generally not designed to control.

Vacuuming is considered the most reliable method of cleaning dusty surfaces, but any effective method that minimizes the likelihood of re-entrainment may be used (for example, a wet floor scrubber). When vacuuming equipment is used, the vacuums must be equipped with high-efficiency particulate air (HEPA) filters. Blowing with compressed air is generally prohibited as a cleaning method, unless the compressed air is used in conjunction with a ventilation system that is designed to capture the airborne dust created by the compressed air (e.g., dust "blowdown" inside a negative-pressure containment structure). In addition, all persons doing the cleanup should be provided with suitable respiratory protection and personal protective clothing to prevent contact with lead.

Where feasible, lead-containing debris and contaminated items accumulated for disposal should be wet-misted before handling. Such materials must be collected and put into sealed impermeable bags or other closed impermeable containers. Bags and containers must be labeled to indicate they contain lead-containing waste.

PERSONAL HYGIENE PRACTICES: Personal hygiene is also an important element in any program to protect workers from exposure to lead dust. When employee exposure is above the PEL, the lead standard requires the Park to provide, and ensure that workers use, adequate shower facilities (where feasible), hand-washing facilities, clean change areas, and separate non-contaminated eating areas. Employees must also wash their hands and faces prior to eating, drinking, using tobacco products, or applying cosmetics, and they must not eat, drink, use tobacco products, or apply cosmetics in any work area where the PEL is exceeded. In addition, employees must not enter lunchroom facilities or eating areas while wearing protective work clothing or equipment unless surface lead dust has first been removed from the clothing or equipment by vacuuming or another cleaning method that limits dispersion of lead dust.

Workers who do not shower and change into clean clothing before leaving the worksite may contaminate their homes and vehicles with lead dust. Other members of the household may then be exposed to harmful amounts of lead. A recent NIOSH publication (NIOSH 1992) points out the dangers of "take-home" lead contamination. For the same reason, vehicles driven to the worksite should be parked where they will not be contaminated with lead.

The personal hygiene measures described above will reduce worker exposure to lead and decrease the likelihood of lead absorption caused by ingestion or inhalation of lead particles. In addition, these measures will minimize employee exposure to lead after the work shift ends, significantly reduce the movement of lead from the worksite, and provide added protection to employees and their families.

CHANGE AREAS: When employee airborne exposures to lead are above the PEL, the Park must provide employees with a clean change area that is equipped with storage facilities for street clothes and a separate area with facilities for the removal and storage of lead-contaminated protective work clothing and equipment. Separate clean and dirty change areas are essential in preventing cross-contamination of the employees' street and work clothing.

Clean change areas are used to remove street clothes, to suit up in clean protective clothing, and to don respirators prior to beginning work, and to dress in street clothes after work. No lead-contaminated items are permitted to enter the clean change area.

Work clothing should be worn only on the job site. Under no circumstances should lead-contaminated work clothes be laundered at home or taken from the worksite, except to be laundered professionally or properly disposed of following applicable Federal, State, and local regulations.

SHOWERS: When employee exposures exceed the PEL, the Park must provide employees with suitable shower facilities, where feasible, so that exposed employees can remove accumulated lead dust from their skin and hair prior to leaving the worksite. Where shower facilities are available, employees must shower at the end of the work shift before changing into their street clothes and leaving the worksite. Showers must be equipped with hot and cold water, in accordance with 29 CFR 1926.51(f)(4)(iv).

WASHING FACILITIES: Washing facilities must be provided to employees in accordance with the requirements of 29 CFR 1926.51(f). Water, soap, and clean towels are to be provided for this purpose. Where showers are not provided, the Park must ensure that employees wash their hands and faces at the end of the work shift.

EATING FACILITIES: The Park must provide employees who are exposed to lead at levels exceeding the PEL with eating facilities or designated areas that are readily accessible to employees and must ensure that the eating area is free from lead contamination. To further minimize the possibility of food contamination and reduce the likelihood of additional lead absorption from contaminated food, beverages, tobacco, and cosmetic products, the employer must prohibit the storage, use, or consumption of these products in any area where lead dust or fumes may be present.

PERIODIC INSPECTION AND MAINTENANCE: Periodic inspection and maintenance of process equipment and control equipment, such as ventilation systems, is another important work practice control. At worksites where full containment is used as an environmental control, the failure of the ventilation system for the containment area can result in hazardous exposures to workers within the enclosure. Equipment that is near failure or in disrepair will not perform as intended. Regular inspections can detect abnormal conditions so that timely maintenance can be performed. If process and control equipment is routinely inspected, maintained, and repaired, or is replaced before failure occurs, there is less chance that hazardous employee exposures will occur.

PERFORMANCE OF TASK: In addition to the work practice controls, the Park must provide training and information to employees as required by OSHA's lead in construction (29CFR 1926.62), hazard communication (29 CFR 1926.59), and safety training and education (29 CFR 1926.21) standards. One important element of this program is training workers to follow the proper work practices and procedures for their jobs. Workers must know the proper way to perform job tasks to minimize their exposure to lead and to maximize the effectiveness of engineering controls. For example, if a worker performs a task away from (rather than close to) an exhaust hood, the control measure will be unable to capture the particulates generated by the task and will thus be ineffective.

In certain applications such as abatement in buildings, wet methods can significantly reduce the generation of lead-containing dust in the work area. Wetting of surfaces with water mist prior to sanding, scraping, or sawing, and wetting lead-containing building components prior to removal will minimize airborne dust generation during these activities. Failure to operate engineering controls properly may also contaminate the work area. Workers can be informed of safe operating procedures through fact sheets, discussions at safety meetings, and other educational means.

SUPERVISION: Good supervision is another important work practice. It provides needed support for ensuring that workers follow proper work practices. By directing a worker to position the exhaust hood properly or to improve work practice, such as standing to the side or upwind of the cutting torch to avoid the smoke plume, a supervisor can do much to minimize unnecessary employee exposure to airborne contaminants.

The OSHA construction standard for lead also requires that a competent person perform frequent and regular inspections of job sites, materials, and equipment. A competent person is defined by the standard as one who is capable of identifying existing and predictable lead hazards and who has authorization to take prompt corrective measures to eliminate them.

ADMINISTRATIVE CONTROLS: Administrative controls are another form of work practice controls that can be used to influence the way a task is performed. Controls of this type generally involve scheduling of the work or the worker. For example, scheduling activities or tasks in ways that minimize employee exposure levels can control employee exposure. One method the Park can use is to schedule the most dust-or fume-producing operations for a time when the fewest employees will be present.

Another method is rotation, which involves rotating employees into and out of contaminated areas in the course of a shift, thereby reducing the full-shift exposure of any given employee. When a worker is rotated out of the job that involves lead exposure, he or she is assigned to an area of the worksite that does not involve lead exposure. If this method is used to control worker exposure to lead, the lead standard requires that the employer implement a job rotation schedule that: (1) identifies each affected worker; (2) lists the duration and exposure levels at each job or work station where each affected employee is located; and (3) lists any other information that may be useful in assessing the reliability of administrative controls to reduce exposure to lead.

OPERATIONS: This section describes the job operations that take place at worksites and involve worker exposures to lead. Although this list of operations is extensive, it is not necessarily inclusive (i.e., other activities not mentioned here may also involve lead exposure). OSHA's lead standard for construction applies to any activity that potentially exposes workers to airborne concentrations of lead.

OPEN ABRASIVE BLAST CLEANING: The most common method of removing lead-based paints is open abrasive blast cleaning. The abrasive medium, generally steel shot/grit, sand, or slag, is propelled through a hose by compressed air. The abrasive material abrades the surface of the structure, exposing the steel substrate underneath. The abrasive also conditions the substrate, forming a "profile" of the metal, which improves the adherence of the new paint. Work is generally organized so that blasting proceeds for approximately one-half day, followed by compressed air cleaning of the steel and application of the prime coat of paint. Prime coat painting must follow blasting immediately to prevent surface rust from forming. Intermediate or finish coats of paint are applied later.

Structures that are typically cleaned by open abrasive blasting are bridges, tanks and towers, locks and dams, pipe racks, pressure vessels and process equipment, supporting steel, and metal buildings. Until recently, abrasive-blasting work was conducted in unobstructed air. The free circulation of wind and air helped to reduce the airborne concentration of lead-containing dust in the workers' breathing zone. Tarpaulins were generally used only to protect neighboring buildings and automobiles from a damaging blast of abrasive or to reduce complaints about over-spray, dust, and dirt.

Currently, some State and local regulations require the use of enclosures or containment structures to prevent the uncontrolled dispersal of lead dust and debris into the environment. Although containment structures are designed to reduce the dispersion of lead into the environment, they usually increase worker exposure to airborne lead, reduce visibility, and increase the risk of slip and fall injuries due to waste material build-up on the footing surface of the enclosure.

Containment structures vary in their design and in their effectiveness in containing debris. Some containment structures consist of tarpaulins made of open mesh fabrics (screens) that are loosely fitted around the blasting area; some use rigid materials such as wood, metal, or plastic to enclose the blasting area; and some use a combination of flexible and rigid materials. Large air-moving devices may be connected to the enclosed containment structure to exhaust dust-laden air and create a negative pressure with respect to the ambient atmosphere.

Containment or enclosure structures can be broadly classified as either partial or full. Partial containment refer to those that inherently allow some level of emission to the atmosphere outside of the containment. An example of a partial containment is a structure with loosely hung permeable tarps and partially sealed joints and entryways. Full containment refers to a relatively tight enclosure (with tarps that are generally impermeable and fully sealed joints and entryways) where minimal or no fugitive emissions are expected to reach the outside environment. Partial or full containment can be used to contain entire structures or portions thereof.

Examples of the kinds of engineering controls and work practices that can be implemented to protect blasting workers are presented below.

ENGINEERING CONTROLS:

- Containment/ventilation systems should be designed and operated so as to create a negative pressure within the structure, which reduces the dispersion of lead into the environment. The containment/ventilation system should be designed to optimize the flow of ventilation air past the worker(s), thereby reducing the airborne concentration of lead and increasing visibility. This can be accomplished by employing either a downdraft or crossdraft ventilation system that is properly balanced by a make-up air supply. Designs for the containment structure and ventilation systems should be specific to each task, because conditions can vary substantially from one worksite to another. The dust-laden air must be filtered prior to its release into the atmosphere.
- Mini-enclosures, which have smaller cross-sectional areas than conventional enclosures, can be erected. Mini-enclosures have advantages over larger conventional enclosures because the same size fan and dust collector can achieve much higher velocities past the helmets of the workers. Mini-enclosure containment structures are usually lightweight, low wind-loading structures that isolate that area where blasting and surface priming is taking place on a given day.
- The risk of silicosis is high among workers exposed to abrasive blasting with silica-containing media, and this hazard is difficult to control. The National Institute for Occupational Safety and Health (NIOSH) has therefore recommended since 1974 that silica sand (or other substances containing more than 1% crystalline silica) be prohibited as abrasive blasting material. A variety of materials such as slags and steel grit are available as alternative blasting media. Because some substitute materials may have their own unique hazards, the MSDS for the substitute material should be consulted before it is used.
- Blast cleaning with recyclable abrasive such as steel grit or aluminum oxide requires specialized equipment for vacuuming or collecting the abrasive for reuse, separating the lead dust and fines from the reusable abrasive, and, in the case of steel grit, maintaining clean, dry air to avoid rusting of the abrasive. In addition, the abrasive classifier must be extremely efficient in removing lead dust, to prevent it from being reintroduced into the containment and combining with the paint to

increase worker exposures. Recycling equipment must be well maintained and regularly monitored to ensure it is removing lead effectively.

- When site conditions warrant, less dusty methods should be used in place of open abrasive blast cleaning. These include:

  _ Vacuum-blast cleaning,
  _ Wet abrasive blast cleaning,
  _ High-pressure water jetting,
  _ High-pressure water jetting with abrasive injection,
  _ Ultrahigh-pressure water jetting,
  _ Sponge jetting,
  _ Carbon-dioxide (dry-ice) blasting,
  _ Chemical stripping, and
  _ Power-tool cleaning.

WORK PRACTICE CONTROLS: Parks engaged in open abrasive blast cleaning operations should implement the following control measures:

- Develop and implement a good respiratory protection program in accordance with OSHA requirements in 29 CFR 1910.134.
- Provide workers with Type CE abrasive-blast respirators; these are the only respirators suitable for use in abrasive-blasting operations. Currently there are only three models of Type CE abrasive blast respirators certified by MSHA/ NIOSH, they are a:

  _ continuous-flow respirator with a loose-fitting hood and has a protection factor of 25,
  _ continuous-flow respirator with a tight-fitting face-piece and has a protection factor of 50,
  _ pressure-demand respirator with a tight-fitting face-piece and has a protection factor of 2000.

The first two models (i.e., the continuous-flow respirators) should be used only for abrasive blast operations where the abrasive materials do not include silica sand and the level of contaminant in the ambient air does not exceed 25 or 50 times the recommended exposure limit, respectively. The third model, which is a pressure-demand respirator, must be worn whenever silica sand is used as an abrasive material (NIOSH 1993).

- Ensure to the extent possible that workers are upstream from the blasting operation to reduce their exposure to lead dust entrained in the ventilation air.

<u>VACUUM BLAST CLEANING</u>: Vacuum blasting is a variation of open abrasive blasting. In this configuration, the blast nozzle has local containment (a shroud) at its end and containment is usually accomplished by brush-lined attachments at the outer periphery and a vacuum inlet between the blast nozzle and the outer brushes (Waagbo and McPhee 1991). The brushes prevent dispersion of the abrasive and debris as they rebound from the steel surface. These particles are removed from the work area by the built-in vacuum system. The abrasive itself can either be disposed of or cleaned and recycled.

If used properly, vacuum blast cleaning can achieve cleaning of good quality with minimal dust generation except in areas where access is difficult because of configuration (such as between back-to-back angles). A variety of heads are available to achieve a tight seal for inside corners, outside corners, and flat surfaces. The advantages of vacuum blasting are that most of the waste material and abrasive is collected at the site of generation and is therefore not transported to the breathing zone of the worker, and that there may be little or no need for containment.

Vacuum blasting has several disadvantages (Knoy 1990). It is more time-consuming than conventional open abrasive blasting because the abrasive blast nozzle must be smaller to capture the ricocheting abrasive and dust. This restricts the dispersion of the abrasive and thus the size of the area that can be cleaned. Abrasive also may escape the vacuum head if the brush attachments do not seal completely around the substrate; operator fatigue, poor work practices or irregular surfaces and edges may cause poor seals. Small areas and areas with gross irregularities cannot be effectively sealed by the shroud. The vacuum system and brushes obscure the blast surface, and some areas may therefore need to be blasted repeatedly because they are missed on the first or second pass. In addition, some vacuum heads are so heavy that mechanical suspension systems are needed to support them, and even then, the blasters may need to take frequent breaks.

<u>WET ABRASIVE BLAST CLEANING</u>: Wet abrasive blast cleaning is a modification of traditional open abrasive blast cleaning. This system uses compressed air to propel the abrasive medium to the surface being cleaned; however, water, which reduces dusting, is injected into the abrasive stream either before or after the abrasive exits the nozzle.

The disadvantages of using water are that inhibitors may be necessary to avoid flash rusting, the containment must be designed to capture the water and debris generated by the cleaning process, wet abrasive/paint debris is more difficult to handle and transport than dry debris, and, unless the water can be filtered, it may add to the volume of debris generated. Because many corrosion inhibitors (e.g., nitrates, nitrites, and amines) raise industrial hygiene concerns, their use must be considered carefully.

<u>HIGH-PRESSURE WATER JETTING:</u> High-pressure water jetting (6,000 to 25,000 psi) utilizes a pressure pump, a large volume of water, a specialized lance and nozzle assembly and, in some cases, a supply of inhibitors to prevent flash rusting. High-pressure water can remove loose paint and rust, but will not efficiently remove tight paint or tight rust, or mill scale. This technique does not create a profile (mechanically induced toothing pattern to enhance the adhesion of high-performance coatings) on its own, but if the original surface was blast cleaned, high-pressure water jetting can be used to remove the old paint and restore the original profile.

Because of the water, this kind of jetting generates little dust. The containment must be constructed to collect water rather than to control dust emissions. The debris generated is comprised of the removed paint and rust, along with the water. If the lead debris can be adequately filtered from the water, the volume of debris is low. If not, the volume of debris can be high. Typically, 5 to 10 gallons of water per minute are used.

Productivity can be high with this method if the objective is to remove only loose, flaky paint. If the objective is to remove tight paint, productivity may be low. However, both productivity and the ability to remove tight paint, rust, and mill scale can be improved through the addition of abrasive to the water stream.

<u>HIGH-PRESSURE WATER JETTING WITH ABRASIVE INJECTION:</u> This system uses an expendable abrasive that is metered into a pressurized water jet (6,000 to 25,000 psi) for surface preparation. Although airborne lead exposures are virtually eliminated with this approach, wet abrasive is more difficult to handle and move than dry abrasive, and the volume of debris also increases. Because the abrasive exposes the bare substrate, inhibitors such as sodium nitrate or amines are often added to the water to prevent flash rusting.

Abrasives used for injection include sand and slag materials, as well as soluble abrasives such as sodium bicarbonate. The sodium bicarbonate will not remove paint, rust, and mill scale as efficiently as sand or slag abrasives. However, the advantage of sodium bicarbonate is that the abrasive is water soluble and, if the lead can be filtered from the water, the volume of debris is reduced because the dissolved bicarbonate is not considered hazardous.

<u>ULTRAHIGH-PRESSURE WATER JETTING:</u> Ultrahigh-pressure water jetting utilizes pressurized water at pressures in excess of 25,000 psi. Ultrahigh-pressure water jetting is similar to high-pressure water jetting except that the ultrahigh variant uses even higher pressures. This means that it cleans more efficiently and removes tight paint and rust more effectively. In addition, the volume of water required is reduced, with less than 5 gallons per minute typically used. Because of the water, little dust is generated. The greatest disadvantage of this process is the difficulty of collecting the contaminated water; wherever the water goes, it carries debris

with it. Dust generation, debris generation, and the type of containment necessary in ultrahigh-pressure water jetting are comparable to those in high-pressure water jetting. Inhibitors are also often required to avoid flash rusting. Mill scale is not removed; however, if the surface was previously blast cleaned, the profile of the original substrate can be restored.

SPONGE JETTING: Sponge jetting involves the use of specialized blasting equipment that propels a combination of an abrasive material (e.g., steel, garnet) encased in a soft sponge (foam) medium. The high-density foam-cleaning medium is absorptive and can be used either wet or dry. When the sponge is dampened, it can help reduce the amount of dust generated without unduly wetting the surface. The medium provides the impact needed to break the paint coating up into larger particles, and particle rebound is low because of the energy absorbed by the foam.

The relatively small volume of dust generated by this method can help to reduce containment requirements, although some screens and tarping are necessary to isolate the work area and to allow the sponge and debris to be collected. Productivity is lower than for open abrasive blasting using more traditional abrasives, according to contractors who have used this product (CONSAD 1993).

CARBON-DIOXIDE (DRY-ICE) BLASTING: Cryogenic cleaning by blasting with dry-ice pellets is one of the least-tried methods of surface preparation A stream of pellets cooled to about -100 degrees F (-79 degrees C) moves at high velocity through a blast hose and nozzle. The pellets impinge on the surface and then sublime, leaving only paint debris to be cleaned up. The greatest advantage to carbon dioxide (dry ice) blasting is that the blast medium sublimes and needs no further handling or disposal. However, when used in confined spaces, the potential for creating an oxygen-deficient environment is significant and must always be guarded against.

The cost of cryogenic cleaning, however, is still often prohibitive. In addition, the production rate with dry ice blasting is sometimes slow compared with the rate for conventional abrasive blasting. Finally, because only the paint is removed, the surface may need to be "brush-off" blasted with an abrasive to produce a rough surface to facilitate adhesion of the new coating.

WELDING, BURNING, AND TORCH CUTTING: Welding and cutting activities that potentially involve exposure to lead can occur as part of a number of construction projects such as highway/railroad bridge rehabilitation (including elevated mass-transit lines), demolition, and indoor and outdoor industrial facility maintenance and renovation. Lead exposures are generated when a piece of lead-based painted steel is heated to its melting point either by an oxyacetylene torch or an arc welder. In this situation, lead becomes airborne as a volatilized component of the coating.

The amount of time a worker may spend actually welding or cutting can vary from only a few minutes up to a full shift. In addition, the coating being worked on may consist of several layers of lead-based paint, each of which could contain as much as 50% lead. Taken together, these factors suggest that a worker's exposure to airborne lead during welding or cutting activities can vary widely and may be exceedingly high.

ENGINEERING CONTROLS: The controls that can be used, depending on feasibility, are:

- Local exhaust ventilation (LEV) that has a flanged hood and is equipped with HEPA filtration may be appropriate where the use of LEV does not create safety hazards. Use of a flexible duct system requires that the welder be instructed to keep the duct close to the emission source and to ensure the duct is not twisted or bent.
- A fume-extractor gun that removes fumes from the point of generation is an alternative to an exhaust hood for gas-shielded arc-welding processes. Such extraction systems can reduce breathing zone concentrations by 70% or more (Hughes and Amendola 1982). These systems require that the gun and shielding gas flow rates be carefully balanced to maintain weld quality and still provide good exhaust flow.

- A longer cutting torch can be used in some situations to increase the distance from the lead source to the worker's breathing zone.
- Hydraulic shears can sometimes be used to mechanically cut steel that is coated with lead based-paint. The use of this method is limited by the ability of the shears to reach the cutting area.
- Whenever possible, pneumatic air tools should be used to remove rivets in lieu of burning and torch cutting.

WORK PRACTICE CONTROLS: The following work practice controls will help to reduce worker exposures to lead during welding, burning, and torch cutting:

- Strip back all lead-based paint for a distance of at least 4 inches in all directions from the area of heat application. Chemical stripping, vacuum-shrouded hand tools, vacuum blasting, or other suitable method may be used. However, in enclosed spaces, strip back or protect the workers with air-line respirators in accordance with the requirements of 29CFR 1926.354(c).
- Ensure that workers avoid the smoke plume by standing to the side or upwind of the cutting torch whenever the configuration of the job permits.
- Prohibit burning to remove lead-based paint. Paint should be removed using other methods, such as chemical stripping, power tools (e.g., needle guns) with vacuum attachments, etc.

SPRAY PAINTING WITH LEAD-BASED PAINT: In the construction field, the primary source of lead exposure in painting is red lead primers, although many finish coatings continue to contain a small percentage of lead. For most interior or exterior construction painting projects, workers employ conventional compressed-air spray equipment. Overspray and rebound of the paint spray off the structure being painted increases the inhalation hazards to workers using lead-based paint. The magnitude of the painter's particulate exposure to lead is dependent on the product used, its lead content, and the quantity of paint applied.

ENGINEERING CONTROLS: The following engineering controls will reduce or eliminate worker exposures to lead during painting:

- Applying non-lead containing paints and primers.
- To the extent possible, replacing lead chromate with zinc.
- Hand-applying lead-based paint by brush or roller coating methods rather than spray methods.
- Using local exhaust ventilation with proper filtration. (The ability to use LEV may be limited by location of the painting operation.)

MANUAL SCRAPING AND SANDING OF LEAD-BASED PAINTS: Hand scraping of lead-based paints involves the use of a hand-held scraping tool to remove paint from coated surfaces. The health hazards in this activity are caused by the lead dust and paint chips produced in the scraping process. Hand sanding can also produce excessive dust. These activities are typically performed during residential and commercial/institutional lead abatement projects.

ENGINEERING AND WORK PRACTICE CONTROLS: The controls that employers can implement to protect workers performing scraping and sanding of lead-based paints are:

- Use of wet-sanding and wet-scraping methods in conjunction with HEPA vacuuming or HEPA mechanical ventilation. Wet methods include misting of peeling paint with water before scraping, and sanding and misting of debris prior to sweeping or vacuuming.
- Use of shrouded power tools with HEPA vacuum attachments. The shroud must be kept flush with the surface.
- Use of techniques with known low exposure potential, such as encapsulation and removal or replacement instead of hand scraping and hand-sanding.

MANUAL DEMOLITION AND/OR REMOVAL OF PLASTER WALLS OR BUILDING COMPONENTS: Striking a wall with a sledgehammer or similar tool usually performs the demolition of lead-painted plaster walls or building components. This results in an uncontrolled release of dust. High levels of airborne total dust and breaking lead-painted plaster into small pieces can generate lead dust.

Removal and replacement is the process of removing components (such as windows, doors, kitchen cabinets, and trim) that have lead-painted surfaces and installing new components that are free of lead-containing paint. Exposures may result from the release of dust and paint-chip particles when these items are removed with a prybar or cut with a saw. Unless the component is seriously deteriorated occupational exposures during this operation are minimal.

ENGINEERING AND WORK PRACTICE CONTROLS: The engineering controls and work practices used to reduce lead exposures during demolition/removal of architectural components are:

- Install partitions or other temporary barriers to allow for partial containment of dust to minimize exposures to other workers and building occupants.
- Keep surfaces and debris moist when disturbing them.
- Remove wallboard by cutting it into large pieces/sections with a carpet knife or shrouded saw with HEPA vacuum attachment.

HEAT-GUN REMOVAL OF LEAD-BASED PAINT: In this activity, the worker uses a heat gun, a tool similar in design to a hand-held hair dryer. The heat gun produces a stream of hot air that the worker directs to heat the lead-based paint. This heat separates the substrate, which is subsequently scraped off with a putty knife or similar tool. The health hazards encountered are generated by lead fumes released into the air during the heating process and lead particulates created during the scraping process.

ENGINEERING AND WORK PRACTICE CONTROLS: The controls used to reduce lead exposure during heat gun operations are:

- Provide thermostatic control for heat guns to restrict operating temperatures to the lowest temperature that will allow for the effective removal of lead-based paint. [Note: HUD places a 700 degrees F limit on the use of heat guns. However, NIOSH (1990) reports that the 700 degrees F restriction for heat-gun nozzle airstream temperatures appears to limit the effectiveness of the guns in removing paint. To compensate for the airstream temperature limitation, workers often hold the gun nozzle close to the surfaces (less than one inch). This reduces the surface area heated and potentially increases the time required for paint removal and prolongs the duration of exposure. On the other hand, commercial heat guns operating at airstream temperatures of 1000 degrees F can generate and disperse high levels of airborne lead.]
- Use techniques with known low exposure potential such as encapsulation and removal/replacement instead of hand scraping with a heat gun.

CHEMICAL STRIPPING OF LEAD-BASED PAINT: Chemical stripping of old paint coatings is performed by applying solvent-or caustic-based strippers to the surface, either by hand or spray gun. The product remains on the surface for a period ranging from 5 minutes to 48 hours, depending on the thickness and composition of the paint being removed. Mechanical scrapers, a vacuum system, or pressurized water are then used to remove the product and the stripped paint. Finally, a wet-vac system is used to clean the surface, although hard-to-reach areas may not be accessible to the vacuum. This system may employ vibrating brushes to help release the paint from the surface.

Some chemical stripping products are toxic (e.g., methylene chloride) when inhaled or absorbed through the skin, and many are skin irritants or skin corrosives. Consequently, appropriate controls must be implemented when using chemical strippers. Although OSHA does not prohibit the use of methylene chloride-based stripping products, some local, State, and other Federal authorities may prohibit its use in residential units.

In the industrial arena, some disadvantages of chemical stripping are that containment and collection of the waste materials may be difficult and productivity may be low compared with the rate for conventional abrasive blasting. Because chemical stripping removes only the paint, a final abrasive blast must often be performed to remove rust and mill scale and to provide the metal profile required for adhesion of the new paint. Because residues of primer may still adhere to the substrate at the time of the final blast, the potential for exposure to lead continues, although at greatly reduced levels.

ENCAPSULATION OF LEAD-BASED PAINT: Encapsulation refers to processes that make lead paint inaccessible by covering or sealing the lead-painted surfaces. This may be achieved by installing sheet-rock walls on top of the paint, covering surfaces with fiberglass, or recoating housing components with a nonlead-based paint. Encapsulation is the best strategy if it provides relatively long-term protection and does not require routine maintenance to ensure the integrity of the encapsulant. Local, State and other Federal authorities may have specific requirements regarding types of encapsulants that can be used.

If surfaces are peeling or deteriorating and scraping is necessary prior to encapsulation, this method will produce lead dust and paint chips. If encapsulation is used over a surface covered with intact paint, little dust is generated and cleanup and waste disposal problems are therefore minimized.

Encapsulation may be a temporary measure because the lead-based paint that remains under the encapsulant may have to be disturbed at a future time and create a new potential for lead exposure. Encapsulation is particularly attractive as a control method when large surfaces such as walls, ceilings, and floors are involved because encapsulation requires little containment or clean up and does not threaten the environment. Documentation of encapsulation is important because of the potential for exposures to underlying lead-based paint during maintenance, future renovation, and eventual demolition.

ENGINEERING CONTROLS: During encapsulation operations, engineering controls may not be necessary to protect workers from lead exposures. Results from HUD air sampling (NIOSH 1990) indicate that 8-hour TWA exposures are well below 50 mg/m^3 for this activity.

POWER-TOOL CLEANING: Power-tool cleaning involves the use of power-operated impact, grinding, or brushing tools. Power tools available for paint removal include needle guns, disc sanders, grinders, power wire brushes, rotary hammers, rotary peeners, and scarifiers. Each can be used with or without a local exhaust ventilation control. Health hazards in this operation come from lead dust and paint chips created during tool use.

ENGINEERING AND WORK PRACTICE CONTROLS: The following controls are recommended to reduce worker exposures to lead during power-tool cleaning of lead-painted surfaces.

- Use shrouded tools wherever feasible (shrouding can restrict accessibility to the work area) with vacuum attachment to collect dust and debris at the point of generation. Exhaust ventilation must be equipped with an appropriate HEPA filtration/collection system.
- Keep shroud flush with the surface during cleaning. Dust generation is minimal, but dust can escape when cleaning areas are of difficult configuration because it may not be possible to maintain a seal between the tool and the surface in these areas.

USE OF LEAD POTS: This activity involves the use of a lead pot to melt lead for use in (1) cast-iron soil pipe installation, removal, and servicing, (2) electrical cable splicing, and (3) babbitting while re-cabling. The health hazard in these operations arises from lead fumes becoming airborne. These operations are discussed below.

CAST-IRON SOIL PIPE INSTALLATION AND REMOVAL: Lead caulking is used in commercial construction building applications, most commonly in the joining or sealing of cast iron soil pipes. The lead used for this purpose must be liquefied.

The process of heating the lead and applying it as a liquid presents an opportunity for exposure to lead-oxide fumes. The primary exposure to fumes occurs while dipping the ladle into the lead pot, carrying the ladle by hand to the solder area, and pouring solder into the pipe joint. Pot dressing is another source of lead fumes. Additional exposures to lead fumes can occur during repair and maintenance operations in which pipe joints are heated to melt the lead caulking and are then pulled apart.

ENGINEERING CONTROLS: The controls used with lead pots include a portable local exhaust ventilation system mounted directly on or near the pot to control lead fumes, or a thermostatic control device installed on the lead pot to prevent overheating to reduce the amount of lead fumes generated.

WORK PRACTICE CONTROLS: During the repair and removal of cast iron pipes, workers can disconnect the pipe by cutting it (above and below the leaded joints) without creating a lead exposure problem.

ELECTRICAL CABLE SPLICING: The cable splicing performed by electrical utility workers and utility contractors is another example of the use of lead pots. In this operation, the lead is typically melted above ground and then lowered by the assistant to the splicer, who is located in the manhole or underground vault. The splicer pours the lead from one ladle over the copper joint and catches the excess in another ladle held below. This process is repeated several times until the metal is too cold to pour. If needed, the process is repeated. A lead metal sheath is then slipped over the connection and the ends are sealed with molten lead.

ENGINEERING CONTROLS: During cable splicing, the following controls are used: (1) a portable local exhaust ventilation system is mounted directly on or near the lead pot; (2) a thermostatic control device can be installed on the lead pot to prevent overheating and reduce the amount of lead fumes; and (3) rubber or plastic connectors can be used instead of molten lead as the sealing method (NIOSH 1993b).

BABBITTING WHILE RECABLING: Elevators receive new wire ropes (i.e., cables) every 10 to 15 years on average. When re-cabling elevator ropes, it is necessary to secure the ends of the wire ropes in the baskets of thimble rods (sockets) at each end of the cable to keep the multi-strand cable from unwinding. This is accomplished by pouring a tin-based babbitt material into the sockets to keep all of the strands in place within the socket.

ENGINEERING CONTROLS: The tin-based babbitt material is usually melted in a thermostatically controlled pot that keeps the lead at a temperature below that at which it fumes.

This job is done within the confines of the hoist way, which normally has an updraft that will draw lead fumes up through the hoist way and away from the worker and release the fumes over the roof of the building.

Where legally permitted, some elevator companies have switched the wire ropes on older elevators from sockets that utilize poured babbitt metal to wedge clamps or to sockets utilizing a thermoplastic/epoxy mixture

SOLDERING AND BRAZING: Soldering and brazing are techniques that are used to join metal pieces or parts. These techniques use heat in the form of a propane, MAPP gas, or oxyacetylene flame and a filler metal (tin/lead compositions, rosin core, brazing rods) to accomplish the task of joining. Workers in the plumbing trades usually perform this activity. The potential exposure source is the filler metal that contains lead.

Soldering and brazing operations present similar health hazards (airborne lead fumes) but to a different degree. Most soldering operations occur at temperatures that are less than 800 degrees F. The melting point of the filler metals is usually quite low (< 600 degrees F) and the activity does not generate significant concentrations of metal fumes. Brazing operations usually occur at temperatures in excess of 800 degrees F. The temperature of the operation is of major importance because temperature determines the vapor pressure of the metals that are heated and therefore the potential concentration of metal fumes to which the employee may be exposed.

Because most field soldering and brazing work is conducted with a torch, it is difficult to regulate operating temperatures to within recommended limits to reduce the amount of metal fumes generated. However, worker 8-hour TWA exposures to metal fumes are usually low due to the limited duration of exposure associated with soldering and brazing work. Electricians soldering electrical connections, plumbers soldering non-potable water lines or roofers repairing tin flashing could all experience these short-term and intermittent lead exposures.

ENGINEERING CONTROLS: In confined areas, portable local exhaust ventilation can be used to remove metal fumes and gases associated with this type of work.

<u>REINSULATION OVER EXISTING MINERAL WOOL:</u> Mineral wool insulation manufactured before about 1970 has been found to have lead particles. According to industry sources, lead slag is no longer used in the manufacture of mineral wool, although lead can be present as a trace impurity (CONSAD 1993).

Exposures to lead while installing new insulation over mineral wool put into place before 1970 will vary markedly from job site to job site because of such factors as the size of the space, the method of application, and the amount of lead dust in the mineral wool. Workers perform this work in relatively confined areas (such as an attic) or in an open bay structure. Moreover, the worker can install insulation manually (e.g., when installing rigid pre-formed insulation around pipes) or mechanically using, for example, a pneumatic blower (e.g., when blowing fiberglass or mineral wool into place over existing mineral-wool insulation). Exposures are likely to be highest when insulation is blown into place in a confined space. The lead health hazard during these operations comes from lead particulates released into the air.

ENGINEERING CONTROLS: No feasible controls are known to exist for this operation.

<u>REMOVAL AND REPAIR OF STAINED-GLASS WINDOWS</u>: The removal and repair of stained-glass windows includes several distinct activities:

- Removing the glass from the building, Tracing the location of the pieces of glass,
- Disassembling the lead strips ("came") and removing the lead putty seals,
- Cleaning or replacing of the individual pieces of glass, and
- Reassembling and soldering the "came."

Only the first activity, removal, takes place at the construction site. Health hazards arise from lead dust released into the air during glass removal. The other activities typically take place in a workshop and are therefore covered under the general industry lead standard (29 CFR 1910.1025).

ENGINEERING AND WORK PRACTICE CONTROLS: Pre-cleaning the stained-glass window with HEPA vacuums or damp wiping to remove loose dust before removal could lower exposures during removal. Whenever feasible, use portable local exhaust ventilation.

<u>ENCLOSURE MOVEMENT:</u> Moving containment enclosures involves the setting up, tearing down, and handling of flexible nylon, plastic, and cotton tarpaulins as well as framing members, which together form the sides of the enclosure. Projects such as the abrasive blasting of bridges, buildings, water towers, and storage tanks are likely to involve some type of containment structure.

Generally, the sequence of events in setting up, tearing down, and moving of a containment structure on a building project is as follows. First, a section of the building is blast-cleaned and primed within the enclosure. After completion, the sides of the containment (tarpaulins and framing) are dismantled so that the structure can be moved forward to the next section of the building to be worked on. After relocating the containment structure, the framing and plastic nylon coverings for the sides are reinstalled before blasting and repainting operations begin. As the enclosures are torn down and moved, the workers involved are exposed to lead dust generated by the movement of the containment components.

ENGINEERING AND WORK PRACTICE CONTROLS: The inside of the containment should be cleaned prior to tear-down and movement to remove the lead-contaminated dust that accumulates on the walls and ledges. If compressed air is used to clean, the ventilation system of the containment structure must be operating and workers must wear appropriate respirators.

ABRASIVE BLASTING AND REPAINTING ACTIVITIES: In addition to those workers actually performing the abrasive blasting, other workers perform support activities such as pot-tending, operating the recycling and vacuum-truck equipment, and tending the abrasive medium transfer and waste-removal equipment. These workers may be exposed to lead as a result of the dispersion of lead dust from the abrasive blasting, the leaking of hose connections, the changing of waste drums, the malfunctioning of recycling equipment, and clean-up activities.

ENGINEERING CONTROLS: Full containment enclosures provided with exhaust ventilation and conventional cartridge filtration units should be used to reduce lead-dust emissions from the abrasive blasting area and prevent environmental contamination. Small HEPA-filtered vacuum systems should be used to clean lead dust from work clothing and to clean up small spills.

WORK PRACTICE CONTROLS: Regular inspections and timely maintenance of process equipment and control equipment help to eliminate dust leaks and prevent equipment malfunction or failure.

LEAD ABATEMENT ACTIVITIES (COMMERCIAL/INSTITUTIONAL AND RESIDENTIAL): These miscellaneous activities occur in conjunction with lead abatement or in-place management activities that have been previously addressed (i.e., dry hand-scraping, removal, and replacement of building components, heat-gun removal, chemical stripping of lead-based paint, and encapsulation). These ancillary activities include washing, HEPA vacuuming, enclosure set-up and tear-down, and waste disposal.

ENGINEERING CONTROLS: Exposure levels are generally below the PEL during the performance of these activities, and engineering controls are therefore not likely to be necessary.

WORK PRACTICE CONTROLS: Surfaces and debris should be kept moist when they are being disturbed. Before sweeping or vacuuming, dust and debris should be misted with water to reduce airborne dust. Plastic sheeting should also be misted with water before handling to reduce dust.

All retained liquid waste should be poured through a filter cloth to remove paint chips and other debris prior to disposal. Filtered materials as well as other waste and debris should be placed in appropriately labeled, 6-mil plastic bags or sealed containers suitable for the transport of lead waste, and stored in a secure area pending disposal in accordance with State and/or local requirements.

Appendix B: Minimum Air Sampling, Protective Equipment and Engineering Control Guidelines

Until air sampling indicates otherwise, you must assume that employees, when working in areas known to have lead materials, are being exposed to lead above the action level. You do not have to do air sampling if you have objective data or historic air sampling data less than 12 months old. If initial conclusions show that exposures are below 30 mg/m^3, the action level, no more air monitoring is needed, unless you change the process that might result in higher exposures. Air sampling must be conducted if initial exposures exceed the action level. If exposures exceed the, Permissible Exposure Limit, (PEL), you must monitor quarterly. It must continue on this schedule until two successive samples taken seven days apart, fall below the action level or PEL. If samples fall below the PEL but are above the action level then sampling frequency may drop to semi-annually. When results are below the action level then sampling may be discontinued all together, unless, again there is a process change. Below is a chart to be used as a guideline for tasks that Facility Management employees do all the time. Also included are the minimum Protective Equipment and Engineering Control guidelines for some maintenance tasks and abatement procedures. For the key to the alphabet codes please see the next page.

Task	Air Monitoring Techniques	Protective Equipment	Engineering Control
Plumbing, replacement	A	A, B, D	A
** Plumbing, installation	A, OR B	A, B, D,	A,B,C
Carpentry, minor	A	A, D	A
** Carpentry, major	A, OR B	A, D, F, ,	A, B, C, OR D
Electrical repair	A	A, B	A
** Electrical installation	A OR B	A, D, F	A, B, C, OR D
HVAC repair	A	A, B,	A
** HVAC installation	A OR B	A, D, F	A
Paint materials removal, chemically	*** C	B, D, E, G, I,	A
Paint removal, scraping, sanding, heat gun etc.	**** B	A OR B, C, F, H, J	A, B, C OR D
Materials removal e.g. plaster, stucco, wood etc.	**** B	A OR B, C, F, H, J	A, B, C, OR D
* Administrative Work	B		

* If employees are working in areas that have dry, flaking or chalking lead based paint, it would be a good idea to get a sample to insure that they too are below the action level. Dust wiping and lab analysis could suggest a mandatory area air sample.

NOTE: All air sampling filters must be taken to a lab, results take about a week.

Appendix B: (continued): Listed below is the key to the chart above

Air Monitoring Techniques: Air sampling results must be representative of an employees' regular daily activity. This requirement can be met in two ways.

1. Full shift samples may be conducted for each job classification in each work area, or
2. Monitoring may be limited to a sample believed to be exposed to the highest concentrations of lead.

(A) Use a personal sampling air pump with clip on hose and 0.8 micron mixed cellulose ester filter, (MESC), attachment. The filter attachment should be clipped to the collar of the test subject near the respirator. Pump specifications are 960 liters maximum volume and 480 liters minimum set at maximum flow rate of 2.0 liters per minute.

(B) Use an area air-sampling pump when you can seal off the area that the employees are working.

** Depending on the extent of the installation or major carpentry a personal sampling device may be used if you don't have to seal off an area to work. E.g. if your not doing extensive drilling, chipping, breaking, etc., you probably do not have to seal the area to keep lead dust contained.

**** If you are doing exterior work or cannot seal the area then revert back to personal air sampling.

(C) None required. *** Initial sample is be required to determine the PEL. You need to refer to MSDS sheet of chemicals used to strip paint for engineering controls and protective equipment. Also if the chemicals do not remove paint completely and scraping is involved you need to do air sampling. Also have an eye wash station available.

Protective Equipment:

(A) Half Faced Air Purifying Respirator, (APR), with HEPA Cartridge. NOTE: If employee has facial hair, e.g. beard, long sideburns, etc. he will have to shave it off or a Powered Air Purifying Respirator, (PAPR), with proper hood must be used.
(B) Half-Faced APR with HEPA, Organic and Acid Vapor Cartridges, if soldering, using chemicals, etc.
(C) Safety Glasses
(D) Splash Goggles
(E) Face Shield
(F) Full Body Tyvek with Hood and separate shoe covers
(G) Impervious Apron w/Sleeves
(H) Rubber Gloves
(I) Impervious Rubber Gloves
(J) Hard Hat

Engineering Controls:

(A) HEPA Vacuum, recommend 5-gallon wet/dry type with 6-mil bag inserts for ease of cleaning.
(B) Seal area and have dirty and clean change room, hand washing facilities etc.
(C) HEPA Air Filtering Systems capable of creating negative air pressure, insure that the size of the sealed off area does not exceed specifications of the system
(D) HEPA Air Filtering System with Suction Arm

<u>Appendix B: continued:</u> Air Monitoring Record

Employee Name	Job Classification	Type of Sampling	Testing Results and Type of Test	Engineering Controls or type of Respirator Protection	Details of Job Employee was Accomplishing

Letter Codes for Log

A = Area Air Sample
B = Personal Air Sample
C = Dust Wipe
D = XRF
E = Laboratory
F = Half-Face APR w/HEPA
G = PAPR's w/ HEPA

H = Half-Face APR w/HEPA & Organic/Acid Cartridge
I = PAPR's w/ HEPA w/Organic/Acid
J = Safety Goggles
K = Splash Goggles
L = Face Shield
M = Hard Hat

N = Tyvek Full Body Suit
O = Tyvek Shoe Covers
P = Rubber Gloves
Q = Impervious Rubber Gloves
R = Impervious Rubber Apron
S = Negative Pressure HEPA Air Filter Exhaust System

T = HEPA Air Filtering Exhaust w/Arm
U = HEPA Vacuum
V =
W =
X =
Y =
Z =